

**NERRS Science Collaborative Progress Report**  
**Period: 03/01/13 through 08/31/13**

**Project Title:** *Legacy effects of land-use change and nitrogen source shifts on a benchmark system: Building capacity for collaborative research leadership at the Grand Bay Reserve*

**Principal Investigator(s):**

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**Project start date:** 09/15/10; NCE through 09/14/14

**Report compiled by:** R. H. Carmichael (PI)

**Contributing team members and their role in the project:**

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***End-user Participants (formal, in proposal)***

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**A. Progress overview:** State the overall goal of your project, and briefly summarize in one or two paragraphs, what you planned to accomplish during this period and your progress on tasks for this reporting period. This overview will be made public for all reports, including confidential submissions.

***Research goal***

To measure land-use related N source and pathogen changes through time and define the resulting effects on ecosystem and human health in Grand Bay, AL by combining data from land-use models, sediment cores, modern sediment and water samples, ancient shell middens, living native and transplanted bivalves, and environmental attributes that cover time periods from up to 3000 years before present to 2020 for three subwatersheds and their receiving waters.

***Planned activities and anticipated accomplishments***

For this term (Y3: Q3 & Q4), we initially planned to focus on data analysis and writing. In response to stakeholder interests and project outputs, we requested and received a no cost extension that allowed us time for new data collection, additional analyses and more advanced data assimilation. As a result, our efforts have focused on additional dating of sediment cores to fill in data gaps and further analyses of midden shells, including addition of inorganic oxygen and carbon stable isotope data to aid aging of ancient shells (which proved to be problematic due to the fragile structure of shells). We have also continued processing native bivalve samples and performed additional wastewater treatment plant (WTP) sampling, including stable

isotope and microbial analyses. We regularly updated our Facebook page and discussion board and communicated with stakeholders. We have added stakeholders from the MS DEQ and shared data at a meeting with DEQ representatives that focused on excessive point phosphate discharges into Bangs Lake within the Grand Bay reserve boundary, which were captured by our study during and after TS Isaac in fall 2012. We continued training students, technicians, and interns on technical methods.

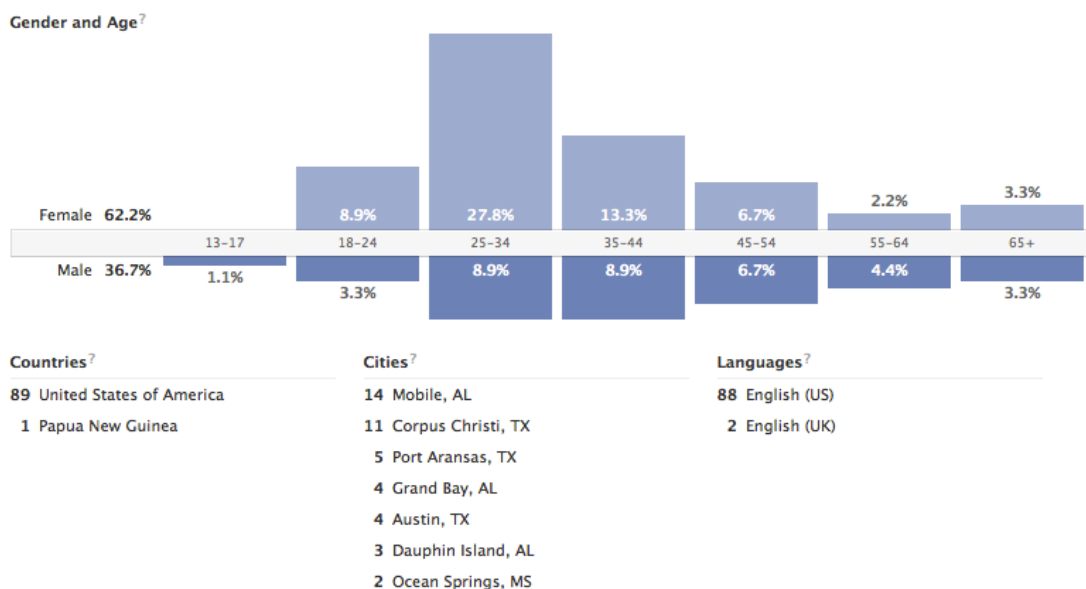
## B. Working with Intended Users:

- Describe the progress on tasks related to the integration of intended users into the project for this reporting period.
- What did you learn? Have there been any unanticipated challenges or opportunities?
- Who has been involved?
- Has interaction with intended users brought about any changes to your methods for integration of intended users, the intended users involved, or your project objectives?
- How do you anticipate working with intended users in the next six months?

1. We continue our collaboration with end user Dr. Ed Jackson to date midden shell samples and collect data that complements his existing data set.

2. Integration Lead, Walton and graduate student Beth Condon maintained the project Facebook Page: <http://www.facebook.com/pages/Grand-Bay-National-Estuarine-Research-Reserve-Science-Collaborative/153046948084497> (open to the public)

Current 'likes' number 111 (up 13% from the last report), with typically close to or more than 200 viewers per post. Posts include research updates and images, particularly by graduate student Condon. This venue has proven useful to update participants and show appreciation for their efforts (Fig. 1).



**Fig. 1.** Current demographics for the Grand Bay National Estuarine Research Reserve Science Collaborative Facebook Page, as of 18 August 2013.

3. Graduate student Condon participated in the University of South Alabama Spring Research Symposium.
4. PI Carmichael and Condon met with Wei Wu and Chuongfung Gong, Co-I and Post-doc (GCRL) to discuss assimilation of GIS data with environmental and microbial data and collaboration for project outputs and manuscripts.
5. PI Carmichael, Condon, and Co-I Ruple (GBNERR) met 26 July 2013 with MS DMR/DEQ, collaborators from University of West Florida (Dr. Jane Caffrey), and other Grand Bay NERR staff to discuss the phosphate spill after TS Isaac.
  - a. Carmichael and Condon gave an overview of the project and presented nutrient data to managers (R. Sumrall, P.E. Chemical Branch Environmental Compliance and Enforcement Division; D. Upton and M. Beiser Field Services Division).
  - b. The group discussed options for outreach to the phosphate plant authorities and future data collection needs to enable requesting and implement change.
6. Condon assisted with the FDA outreach table at the Alabama Deep Sea Fishing Rodeo on Dauphin Island Alabama to discuss seafood safety and relevant project findings with the public.
7. Condon spent 5 days in the laboratory of Dr. Fred Andrus at the University of Alabama, to micromill and conduct inorganic stable isotope ratio analysis (SIA) in ancient shell.
  - a. This no-cost effort was developed during the last grant period and has lead to a cross-discipline collaboration that will help us learn the geochemistry techniques needed to aid age analysis of ancient shells.
  - a. This work will benefit Dr. Andrus, Dr. Jackson and their colleagues because the geologists are interested to incorporate ecology into their analyses and archaeologists are very interested in season-of-capture information to track how native peoples migrated and used historic sites in this region (this aspect complements and builds on our original collaboration with MS Department of Archives and History, Dr. Ed Jackson, and Capt. K. Wilkinson).
  - b.  $\delta^{18}\text{O}$  values will allow more sophisticated aging techniques and more accurate comparison of growth rates in ancient vs. modern oysters, and may allow comparison of temperature variation between ancient and modern periods (which may also affect oyster growth).
  - c. Dr. Andrus is now a member of Condon's graduate committee.

### **C. Progress on project objectives for this reporting period:**

- Describe progress on tasks related to project objectives for this reporting period.
- What data did you collect?
- Has your progress in this period brought about any changes to your methods, the integration of intended users, the intended users involved or the project objectives?
- Have there been any unanticipated challenges, opportunities, or lessons learned?

#### ***Stakeholder participation***

In addition to the stakeholder involvement described above, we continued our communication with the expanded stakeholder group defined in previous quarters. At this time, we have pushed back our next comprehensive stakeholder meeting to spring 2014 when the project will be in its final phase. In the mean time, we plan to attend the GBNERR Research Symposium to disseminate data to endusers and the public (scheduled for 25 October 2013), and we will continue working to include each stakeholder group as well as new contacts in periodic targeted end user meetings. We also shared data on phosphate concentrations in the water column with the GBNERR staff and MS DEQ representatives at the meeting in July (described above).

#### ***Field sampling, lab work and data analyses***

*Sediment cores*—Sediment core data sets for *Clostridium perfringens* (Cp) are completed, and SIA was completed for all cores but one, Bayou Chicot, which had to be sampled by hand due to shallow water depth at the site and delayed sampling; SIA data are pending.

*Oyster transplants*—We completed a full year of oyster transplant experiment and microbial sampling as of 20 May 2013. Oyster growth and SI analyses was completed for 2011, with oyster growth and SIA in progress for 2012-2013. A Directed Study student from University of Illinois-Urbana Champagne has joined the lab for Fall 2013 term to assist with shell morphometrics from our oysters. Her project will include analyses of length to dry weight comparisons among age/size classes, transplanted v. native oysters, and between our sites on the Gulf of Mexico coast with similar data collected on the U.S. Atlantic coast.

*Environmental & microbial data*—We completed our year-round environmental monitoring and microbial sampling associated with oyster transplant sites (as described in previous reports). We have completed all nutrient analyses for 2011 and 2012-2013. We continued working in tandem with Grand Bay NERR staff (Kim Cressman, SWMP coordinator) to evaluate the high phosphate concentrations measured in Bangs Lake (Fig. 2) after TS Isaac. Along with Grand Bay staff and collaborators (described above) we met with AL DEQ representatives, regarding detection of this industrial phosphate spill. We also completed analysis of chlorophyll *a*, suspended particulate matter, and analyses of WTP samples for 2011; the full year of data collection was completed in April 2013. Data analyses for these attributes for 2012-2013 are ongoing. All YSI sonde environmental data have been collected and QA/QC procedures are ongoing.

*Midden shells*—We continued analysis on midden shells, including method development for N and C content on an elemental analyzer to optimize the amount of oyster shell to be analyzed. We also cut midden shells and a few modern shells, mounted them on slides and photographed them for  $\delta^{18}\text{O}/\delta^{13}\text{C}$  determination in shell carbonate (F. Andrus' lab University of Alabama). Data were obtained 19 August 2013 and will be analyzed in the next quarter. We also

conducted SIA on a preliminary set of acidified and bulk midden shell samples and completed determinations of midden shell morphometrics, %N content, and C-14 dates.

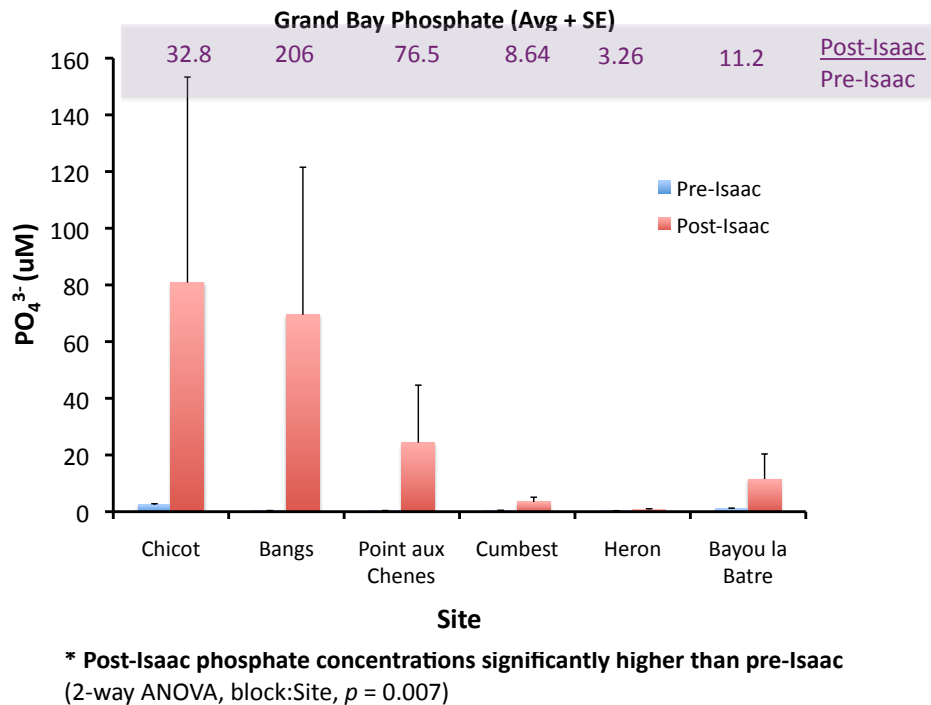


Fig. 2. Water column phosphate concentrations at each study site, averaged over the 12 weeks prior to (Pre-Isaac) and 6 weeks after (Post-Isaac) TS Isaac. Post-Isaac phosphate concentrations were significantly higher than pre-Isaac, and western sites had highest phosphate concentrations. Inset numbers at top represent the ratio of post:pre-Isaac phosphate concentrations for each site. Elevated values in Bayou Chicot reflect a permitted point discharge, while Bangs Lake values reflect the site of spill into the Grand Bay Reserve, and elevated values in Point aux Chenes suggest movement through the system.

### ***Technical training***

- Co-I Calci (FDA) and student Condon continued working on laboratory techniques for the microbiology component of the project at the FDA lab on Dauphin Island.
- PI Carmichael and Condon continued training on shell slicing and acidification techniques in the Carmichael lab for application to midden shells provided by Jackson (USM). The fragile structure of shells and intercollation of biota and sediments has required new methods development and specialized techniques.
- Condon trained on micromilling techniques for inorganic C and O SIA (Fig. 3).
- Condon completed and had her research prospectus approved by her graduate committee, completed her comprehensive qualifying exams, and is preparing a dissertation improvement proposal to submit to NSF to fund additional shell midden analyses.

- Condon incorporated a number of students into the project, by inviting them to assist with field and lab work. Many of these students expressed interest in marine science or biology as a career, and were able to learn techniques such as water quality sampling, oyster sampling, isotope filtering, and YSI data sonde calibration and data analysis. During summer 2013, PI Carmichael hosted interns:
  - a. Amanda Ellenburg (University of South Alabama)
  - b. Nicholas Klinge (Daphne Highschool)
  - c. Morgan Frank (University of South Alabama)
  - d. Renee Edwards (University of Illinois – Urbana Champagne; work will be the senior capstone project for her Masters degree)

These interns worked closely with Condon, learning oyster growth measurements and stable isotope sample preparation techniques. Two of these interns, Ellenburg and Edwards will continue working on the project in the next quarter.

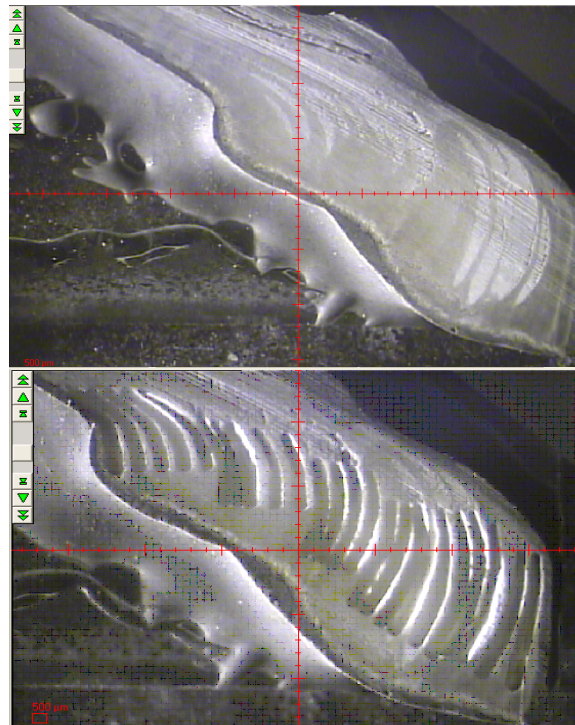


Fig. 3. Example micromill samples from oyster shell sections for determining  $\delta^{18}\text{O}$  and  $\delta^{13}\text{C}$  in shell carbonate. Each “track” represents a shell sample and period of time used to establish length-at-age relationships.

### ***Land-use modeling***

Co-PIs from GCRL continued refining land cover land use mapping.

- What are your plans for meeting project objectives for the next six months?
1. We will continue processing data for the unfinished datasets indicated above.
  2. We will continue operation and maintenance of the Facebook page and Google discussion board.
  3. We plan to hold at least one Working Group and one comprehensive stakeholder meeting during the next 12 months, along with several other targeted meetings with smaller groups of stakeholders.
  4. We plan to give scientific and public presentations and develop publications, as well as continue student and technician training.

**D. Benefit to NERRS and NOAA:** List any project-related products, accomplishments, or discoveries that may be of interest to scientists or managers working on similar issues, your peers in the NERRS, or to NOAA. These may include, but are not limited to, workshops, trainings, or webinars; expert speakers; new publications; and new partnerships or key findings related to collaboration or applied science.

1. See results above from dating efforts above.
2. Ongoing collaboration with the Grand Bay NERR and EPA project by Dr. J. Cebrian, expansion to collaborate with Dr. J. Caffrey at University of West Florida regarding the phosphate spill in Bangs Lake.
3. PI Carmichael and Condon shared data and participated in discussions at a meeting with AL DEQ representatives and Grand Bay NERR staff and other collaborators to address the impacts and implications for the GBNERR from a phosphate spill during and after TS Isaac. Data will be used to guide future data collection and monitoring programs at the reserve and determine how to proceed to avoid and minimize spill effects in the future.
4. Condon presented her work at the Deep Sea Fishing Rodeo on Dauphin Island in July 2013 and has submitted an abstract for an oral presentation at the upcoming Coastal and Estuarine Research Federation meeting in San Diego in Nov 2013. PI Carmichael will also present some of the findings from this study in an oral presentation at that same meeting.
5. PI Carmichael and Condon will present findings at the upcoming Grand Bay NERR Research Symposium in October 2013.

**E. Describe any activities, products, accomplishments, or obstacles not addressed in other sections of this report that you feel are important for the Science Collaborative to know.**

None.